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US 20030075338 A1 US 20030042022 A1

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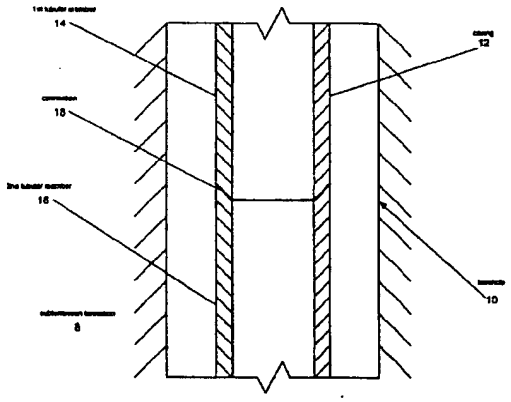
(54) Abstract Title: **A method of radially expanding and plastically deforming tubular members**

(57) A method of radially expanding and plastically deforming a tubular assembly comprising a first tubular member, a second tubular member, and a mechanical coupling for coupling the first tubular member to the second tubular member, the method comprising placing the mechanical coupling in tension; and then radially expanding and plastically deforming the mechanical coupling. It is emphasized that this abstract is provided to comply with the rules requiring an abstract to allow a searcher or other reader to quickly ascertain the subject matter of the technical disclosure; and is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims under 37 CFR 1.72.



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Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv)) for US only*

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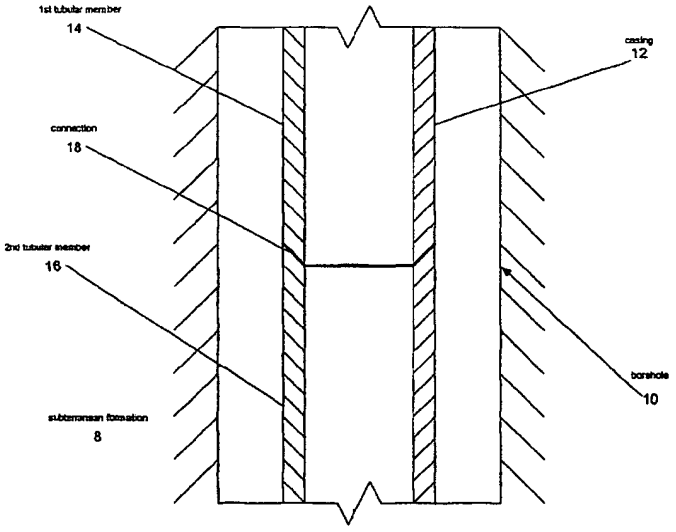
(54) Title: A METHOD OF RADIALLY EXPANDING AND PLASTICALLY DEFORMING TUBULAR MEMBERS



(57) Abstract: A method of radially expanding and plastically deforming a tubular assembly comprising a first tubular member, a second tubular member, and a mechanical coupling for coupling the first tubular member to the second tubular member, the method comprising placing the mechanical coupling in tension; and then radially expanding and plastically deforming the mechanical coupling. It is emphasized that this abstract is provided to comply with the rules requiring an abstract to allow a searcher or other reader to quickly ascertain the subject matter of the technical disclosure; and is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims under 37 CFR 1.72.

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A METHOD OF RADIALLY EXPANDING AND PLASTICALLY DEFORMING TUBULAR MEMBERS

Cross Reference To Related Applications

[001] This application claims the benefit of the filing dates of: 1) U.S. provisional patent application serial number 60/499,576, attorney docket number 25791.215, filed on September 2, 2003, the disclosure of which is incorporated herein by reference.

[002] The present application is related to the following: (1) U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (2) U.S. patent application serial no. 09/510,913, attorney docket no. 25791.7.02, filed on 2/23/2000, which claims priority from provisional application 60/121,702, filed on 2/25/99, (3) U.S. patent application serial no. 09/502,350, attorney docket no. 25791.8.02, filed on 2/10/2000, which claims priority from provisional application 60/119,611, filed on 2/11/99, (4) U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (5) U.S. patent application serial no. 10/169,434, attorney docket no. 25791.10.04, filed on 7/1/02, which claims priority from provisional application 60/183,546, filed on 2/18/00, (6) U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (7) U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (8) U.S. patent number 6,575,240, which was filed as patent application serial no. 09/511,941, attorney docket no. 25791.16.02, filed on 2/24/2000, which claims priority from provisional application 60/121,907, filed on 2/26/99, (9) U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (10) U.S. patent application serial no. 09/981,916, attorney docket no. 25791.18, filed on 10/18/01 as a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (11) U.S. patent number 6,604,763, which was filed as application serial no. 09/559,122, attorney docket no. 25791.23.02, filed on 4/26/2000, which claims priority from provisional application 60/131,106, filed on 4/26/99, (12) U.S. patent application serial no. 10/030,593, attorney docket no. 25791.25.08, filed on 1/8/02, which claims priority from provisional application 60/146,203, filed on 7/29/99, (13) U.S. provisional patent application serial no. 60/143,039, attorney docket no. 25791.26, filed on 7/9/99, (14) U.S. patent application serial no. 10/111,982, attorney docket no.

25791.27.08, filed on 4/30/02, which claims priority from provisional patent application serial no. 60/162,671, attorney docket no. 25791.27, filed on 11/1/1999, (15) U.S. provisional patent application serial no. 60/154,047, attorney docket no. 25791.29, filed on 9/16/1999, (16) U.S. provisional patent application serial no. 60/438,828, attorney docket no. 25791.31, filed on 1/9/03, (17) U.S. patent number 6,564,875, which was filed as application serial no. 09/679,907, attorney docket no. 25791.34.02, on 10/5/00, which claims priority from provisional patent application serial no. 60/159,082, attorney docket no. 25791.34, filed on 10/12/1999, (18) U.S. patent application serial no. 10/089,419, filed on 3/27/02, attorney docket no. 25791.36.03, which claims priority from provisional patent application serial no. 60/159,039, attorney docket no. 25791.36, filed on 10/12/1999, (19) U.S. patent application serial no. 09/679,906, filed on 10/5/00, attorney docket no. 25791.37.02, which claims priority from provisional patent application serial no. 60/159,033, attorney docket no. 25791.37, filed on 10/12/1999, (20) U.S. patent application serial no. 10/303,992, filed on 11/22/02, attorney docket no. 25791.38.07, which claims priority from provisional patent application serial no. 60/212,359, attorney docket no. 25791.38, filed on 6/19/2000, (21) U.S. provisional patent application serial no. 60/165,228, attorney docket no. 25791.39, filed on 11/12/1999, (22) U.S. provisional patent application serial no. 60/455,051, attorney docket no. 25791.40, filed on 3/14/03, (23) PCT application US02/2477, filed on 6/26/02, attorney docket no. 25791.44.02, which claims priority from U.S. provisional patent application serial no. 60/303,711, attorney docket no. 25791.44, filed on 7/6/01, (24) U.S. patent application serial no. 10/311,412, filed on 12/12/02, attorney docket no. 25791.45.07, which claims priority from provisional patent application serial no. 60/221,443, attorney docket no. 25791.45, filed on 7/28/2000, (25) U.S. patent application serial no. 10/, filed on 12/18/02, attorney docket no. 25791.46.07, which claims priority from provisional patent application serial no. 60/221,645, attorney docket no. 25791.46, filed on 7/28/2000, (26) U.S. patent application serial no. 10/322,947, filed on 1/22/03, attorney docket no. 25791.47.03, which claims priority from provisional patent application serial no. 60/233,638, attorney docket no. 25791.47, filed on 9/18/2000, (27) U.S. patent application serial no. 10/406,648, filed on 3/31/03, attorney docket no. 25791.48.06, which claims priority from provisional patent application serial no. 60/237,334, attorney docket no. 25791.48, filed on 10/2/2000, (28) PCT application US02/04353, filed on 2/14/02, attorney docket no. 25791.50.02, which claims priority from U.S. provisional patent application serial no. 60/270,007, attorney docket no. 25791.50, filed on 2/20/2001, (29) U.S. patent application serial no. 10/465,835, filed on 6/13/03, attorney docket no. 25791.51.06, which claims priority from provisional patent application serial no. 60/262,434, attorney docket no. 25791.51, filed on 1/17/2001, (30) U.S. patent application serial no. 10/465,831, filed on 6/13/03, attorney docket no. 25791.52.06, which claims priority from U.S. provisional patent application serial no. 60/259,486, attorney docket no. 25791.52, filed on 1/3/2001, (31) U.S. provisional patent application serial no. 60/452,303, filed on 3/5/03, attorney docket no.

25791.53, (32) U.S. patent number 6,470,966, which was filed as patent application serial number 09/850,093, filed on 5/7/01, attorney docket no. 25791.55, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (33) U.S. patent number 6,561,227, which was filed as patent application serial number 09/852,026 , filed on 5/9/01, attorney docket no. 25791.56, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (34) U.S. patent application serial number 09/852,027, filed on 5/9/01, attorney docket no. 25791.57, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (35) PCT Application US02/25608, attorney docket no. 25791.58.02, filed on 8/13/02, which claims priority from provisional application 60/318,021, filed on 9/7/01, attorney docket no. 25791.58, (36) PCT Application US02/24399, attorney docket no. 25791.59.02, filed on 8/1/02, which claims priority from U.S. provisional patent application serial no. 60/313,453, attorney docket no. 25791.59, filed on 8/20/2001, (37) PCT Application US02/29856, attorney docket no. 25791.60.02, filed on 9/19/02, which claims priority from U.S. provisional patent application serial no. 60/326,886, attorney docket no. 25791.60, filed on 10/3/2001, (38) PCT Application US02/20256, attorney docket no. 25791.61.02, filed on 6/26/02, which claims priority from U.S. provisional patent application serial no. 60/303,740, attorney docket no. 25791.61, filed on 7/6/2001, (39) U.S. patent application serial no. 09/962,469, filed on 9/25/01, attorney docket no. 25791.62, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (40) U.S. patent application serial no. 09/962,470, filed on 9/25/01, attorney docket no. 25791.63, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (41) U.S. patent application serial no. 09/962,471, filed on 9/25/01, attorney docket no. 25791.64, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (42) U.S. patent application serial no. 09/962,467, filed on 9/25/01, attorney docket no. 25791.65, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (43) U.S. patent application serial no. 09/962,468, filed on 9/25/01, attorney docket no. 25791.66, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed

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60/121,841, filed on 2/26/99, (54) U.S. patent application serial no. 10/078,928, attorney docket no. 25791.79, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (55) U.S. patent application serial no. 10/078,922, attorney docket no. 25791.80, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (56) U.S. patent application serial no. 10/078,921, attorney docket no. 25791.81, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (57) U.S. patent application serial no. 10/261,928, attorney docket no. 25791.82, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (58) U.S. patent application serial no. 10/079,276 , attorney docket no. 25791.83, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (59) U.S. patent application serial no. 10/262,009, attorney docket no. 25791.84, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (60) U.S. patent application serial no. 10/092,481, attorney docket no. 25791.85, filed on 3/7/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (61) U.S. patent application serial no. 10/261,926, attorney docket no. 25791.86, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (62) PCT application US 02/36157, filed on 11/12/02, attorney docket no. 25791.87.02, which claims priority from U.S. provisional patent application serial no. 60/338,996, attorney docket no. 25791.87, filed on 11/12/01, (63) PCT application US 02/36267, filed on 11/12/02, attorney docket no. 25791.88.02, which claims priority from U.S. provisional patent application serial no. 60/339,013, attorney docket no. 25791.88, filed on 11/12/01, (64) PCT application US 03/11765, filed on 4/16/03, attorney docket no. 25791.89.02, which claims priority from U.S. provisional patent application serial no. 60/383,917, attorney docket no. 25791.89, filed on 5/29/02, (65) PCT application US 03/15020,

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application serial no. 60/472,240, attorney docket no. 25791.286, filed on 5/20/03. The disclosures of all of which (01-121) are herein incorporated by reference in their entirety.

Field of the Invention

[003] This invention relates to expandable tubular members, and in particular to a method of expanding tubular members.

Background

[004] Conventionally, when a wellbore is created, a number of casings are installed in the borehole to prevent collapse of the borehole wall and to prevent undesired outflow of drilling fluid into the formation or inflow of fluid from the formation into the borehole. The borehole is drilled in intervals whereby a casing which is to be installed in a lower borehole interval is lowered through a previously installed casing of an upper borehole interval. As a consequence of this procedure the casing of the lower interval is of a smaller diameter than the casing of the upper interval. Thus, the casings are in a nested arrangement with casing diameters decreasing in a downward direction. Cement annuli may be provided between the outer surfaces of the casings and the borehole wall to seal the casings from the borehole wall. As a consequence of this nested arrangement a relatively large borehole diameter is required at the upper part of the wellbore. Such a large borehole diameter involves increased costs due to heavy casing handling equipment, large drill bits and increased volumes of drilling fluid and drill cuttings. Moreover, increased drilling rig time is involved due to required cement pumping, cement hardening, required equipment changes due to large variations in hole diameters drilled in the course of the well, and the large volume of cuttings drilled and removed.

[005] In order to avoid the nested arrangement of casing as discussed above, wellbore casings may be formed in the wellbore by radially expanding and plastically deforming tubular members in the borehole. These tubular members are often coupled to one another by threaded connections. The threaded engagement between properly secured tubular members in a conventional casing joint is effective in maintaining a secure mechanical connection that holds the string together and effectively seals the internal casing area from the formation wellbore environment. When the casing string and connection are enlarged radially, a conventional connection changes dimensionally in a way that can prevent the engaged components of the connection from properly engaging and sealing. The radial expansion of a conventional connection may weaken or otherwise damage the connection sufficiently to permit mechanical separation or leakage in the connection.

[006] Furthermore, if a first tubular member is connected to a second tubular member, and then radially expanded and plastically deformed while the connection between the first tubular member and the second tubular member is in compression, the connection may fail during and/or after the radial expansion and plastic deformation.

[007] What is needed is a new method and apparatus to expand a tubular connection.

Brief Description of the Drawings

[008] Fig. 1 is a sectional view through a borehole illustrating a string of casing run in a borehole prior to being radially expanded and plastically deformed.

[009] Fig. 2 is a sectional view through a borehole illustrating a string of casing that has been partially radially expanded and plastically deformed.

[0010] Fig. 3 is a sectional view through a borehole illustrating a string of casing that has been radially expanded and plastically deformed.

[0011] Fig. 4 is a sectional view through a borehole illustrating a string of casing being radially expanded and plastically deformed with an expansion device.

[0012] Fig. 5 is a sectional view through a borehole illustrating a partially expanded string of casing and an expandable expansion device.

[0013] Fig. 6 is a sectional view through a borehole illustrating a string of casing being radially expanded and plastically deformed with two expansion devices.

Detailed Description

[0014] Referring to Fig. 1, there is illustrated a subterranean formation 8, and a borehole 10 positioned in the subterranean formation. As a first step, a string of casing 12 is positioned within the borehole 10. The string of casing 12 includes a first tubular member 14 and a second tubular member 16. The first tubular member 14 and the second tubular member 16 are connected by a conventional mechanical connection 18, for example a conventional threaded connection.

[0015] Referring to Fig. 2, a second step is illustrated where a portion of the first tubular member 14 above the connection 18 has been radially expanded and plastically deformed into engagement with the borehole 10, and a portion of the second tubular member 16 below the connection 18 has been radially expanded and plastically deformed into engagement with the borehole 10. The connection 18 has not been radially expanded and plastically deformed.

[0016] The connection 18 is shown in tension. The first tubular member 14 is exerting a force on the connection 18 in the direction of an arrow 20. The second tubular member 16 is exerting a force on the connection 18 in the direction of an arrow 22.

[0017] It is understood that the connection 18 is in tension because as a portion of the first tubular member 14 is expanded and plastically deformed in a radial direction into engagement with the borehole 10, that portion contracts in an axial direction due to Poisson's ratio, and exerts a tensional force on the connection. Alternatively, the connection 18 is in tension because as a portion of the second tubular member 16 is expanded and plastically deformed in a radial direction into engagement with the borehole 10, that portion contracts in an axial direction due to Poisson's ratio, and exerts a tensional force on the connection. It is understood that both the first tubular member 14 and the second tubular member 16 are held stationary, for example by being expanded into engagement with the borehole 10, in order for the connection 18 to be in

tension. If either the first tubular member 14 or the second tubular member 16 were not held stationary, there would be no tensional force in the connection 18, because the tubular members would move in the direction of the tensional force to relieve the force.

[0018] Referring to Fig. 3, a third step is illustrated where the string of casing 12 has been radially expanded and plastically deformed within the borehole 10. The first tubular member 14 and the second tubular member 16 were radially expanded and plastically deformed into engagement with the borehole 10, as shown in Fig. 2, and then the connection 18 was radially expanded and plastically deformed, as shown in Fig. 3.

[0019] Referring to Fig. 4, there is illustrated a first part of a technique of radially expanding and plastically deforming the string of casing 12 of Fig. 1. An expansion device 22 is used to radially expand and plastically deform portions of the string of casing 12.

[0020] It is understood that suitable expansion devices for the expansion device 22 include conventional expansion devices adjustable between a small diameter configuration and a large diameter configuration. It is also understood that when the expansion device 22 is in the small diameter configuration, the expansion device can fit through the unexpanded connection 18, as shown in Figs. 1 and 2; and when the expansion device is in the large diameter configuration, the expansion device can expand a portion of the first tubular member 14, second tubular member 16, and/or the connection 18, as shown in Figs. 2 and 3.

[0021] Referring again to Fig. 4, a first part of the technique is illustrated where a portion of the second tubular member 16 below the connection 18 is being radially expanded and plastically deformed by the expansion device 22. The expansion device 22 is shown in the large diameter configuration. The expansion device 22 is mounted to a support number 23. It is understood that an area 24 under the expansion device 22 may be pressurized to force the expansion device towards the connection 18 and the first tubular member 14. Alternatively, the expansion device 22 may be pulled by the support member 23 towards the connection 18 and the first tubular member 14.

[0022] It is understood that the expansion device 22 may be lowered through the string of casing 12 in the small diameter configuration, then the expansion device may be expanded to the large diameter configuration, and used to expand a portion of the second tubular member 16. Alternatively, the expansion device 22 may start in the large diameter configuration, and the string of casing 12 may be placed over the support number 23, so that the expansion device is at the bottom of the string of casing, then the expansion device can be pulled through the second tubular member 16 to radially expand and plastically deform the second tubular member.

[0023] Referring to Fig. 5, a second part of the technique is illustrated where the expansion device 22 is in a small diameter configuration moving through the connection 18. It is understood that the expansion device 22 may be used to radially expand and plastically deform a portion of the second tubular member 16 while in a large diameter configuration during the first

part of the technique as illustrated in Fig. 4, then be collapsed into a small diameter configuration and be pulled through the connection 18 by the support number 23, during the second part of the technique as illustrated in Fig. 5.

[0024] It is also understood that after being pulled through the connection 18 and into the first tubular member 14, the expansion device 22 may be re-expanded into the large diameter configuration and used to radially expand and plastically deform a portion of the first tubular member 14, during a third part of the technique.

[0025] After a portion of the second tubular member 16 and a portion of the first tubular member 14 have been radially expanded and plastically deformed with the expansion device 22 in the above described manner, the connection 18 may be radially expanded and plastically deformed with the expansion device 22 or with another expansion device (not shown), during a fourth part of the technique.

[0026] Referring to Fig. 6, there is illustrated a second technique of radially expanding and plastically deforming the string of casing 12 of Fig. 1. A portion of the string of casing 12 is radially expanded and plastically performed with a first expansion device 26 and a second expansion device 28. The first expansion device 26 is mounted on a support member 34. The second expansion device 28 is connected to the first expansion device 26 in a conventional manner by a connecting device 30.

[0027] It is understood that the first expansion device 26 is expandable between a small diameter configuration and a large diameter configuration, while the second expansion device 28 may or may not be expandable between a small diameter configuration and a large diameter configuration.

[0028] In operation, during a first part of the second technique, the first expansion device 26 is used to radially expand and plastically deform a portion of the second tubular member 16 while in a large diameter configuration. During a second part of the second technique, the first expansion device 26 is then retracted into a small diameter configuration and moved through the connection 18. During a third part of the second technique, the first expansion device 26 is expanded into a large diameter configuration and used to radially expand and plastically deform a portion of the first tubular member 14, after moving through the connection 18.

[0029] The second expansion device 28 is pulled by the connecting device 30 behind the first expansion device 26. It is understood that the second expansion device 28 has a fixed diameter. Alternatively, the second expansion device 28 is movable between a first small diameter configuration and a second large diameter configuration.

[0030] After the first expansion device 26 has radially expanded and plastically deformed a portion of the second tubular member 16 and a portion of the first tubular member 14 during the third part of the second technique, during a fourth part the second expansion device 28 is pulled through the connection 18 by the connecting device 30, and the second expansion device

radially expands and plastically deforms the connection. After moving the first expansion device 26 and the second expansion device 28 through the string of casing 12 (shown in Fig. 6) using the second technique, the string of casing may look like the string of casing 12 as illustrated in Fig. 3.

[0031] It is understood that the first expansion device 26 and the second expansion device 28 may be moved through the string of casing 12 by pulling them with the support member 34. Alternatively, the first expansion device 26 and the second expansion device 28 are moved through the string of casing 12 by pressurizing an area 32 under the second expansion device, which pushes the second expansion device, the connecting device 30, and the first expansion device.

[0032] In one embodiment, there is disclosed a method of creating a casing in a borehole located in a subterranean formation, comprising installing the casing in the borehole, the casing comprising a first tubular member, a second tubular member, and a conventional threaded connection coupling the first tubular member to the second tubular member; radially expanding and plastically deforming at least a portion of the first tubular member; radially expanding and plastically deforming at least a portion of the second tubular member; and then radially expanding and plastically deforming the conventional threaded connection. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device. In another embodiment, the radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device. In another embodiment, the radially expanding and plastically deforming the conventional threaded connection comprises radially expanding and plastically deforming the connection with an expansion cone. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with a first expansion device, and wherein radially expanding and plastically deforming the conventional threaded connection comprises radially expanding and plastically deforming the connection with a second expansion device. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member and radially expanding and plastically deforming at least a portion of the second tubular member comprises placing the conventional threaded connection in tension. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole. In another embodiment, the radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

[0033] In one embodiment, there is disclosed a method of creating a casing in a borehole located in a subterranean formation, comprising installing the casing in the borehole, the casing comprising a first tubular member, a second tubular member, and a conventional threaded connection coupling the first tubular member to the second tubular member; placing a first expansion device and a second expansion device in the casing; radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member with the first expansion device; and radially expanding and plastically deforming the conventional threaded connection with the second expansion device. In another embodiment, the radially expanding and plastically deforming the conventional threaded connection is done after radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member. In another embodiment, the first expansion device is expandable. In another embodiment, the first expansion device includes rotating elements.

[0034] In one embodiment, there is disclosed a method of creating a casing in a borehole located in a subterranean formation, comprising installing the casing in the borehole, the casing comprising a first tubular member, a second tubular member, and a third tubular member, a first conventional threaded connection coupling the first tubular member to the second tubular member, and a second conventional threaded connection coupling the second tubular member to the third tubular member; radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member; then radially expanding and plastically deforming the first conventional threaded connection; radially expanding and plastically deforming at least a portion of the third tubular member; and then radially expanding and plastically deforming the second conventional threaded connection. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device. In another embodiment, the radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device. In another embodiment, the radially expanding and plastically deforming at least a portion of the third tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device. In another embodiment, the radially expanding and plastically deforming the first conventional threaded connection comprises radially expanding and plastically deforming the connection with an expansion cone. In another embodiment, the radially expanding and plastically deforming the second conventional threaded connection comprises radially expanding and plastically deforming the connection with an expansion cone. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with a first expansion device,

and wherein radially expanding and plastically deforming the first conventional threaded connection comprises radially expanding and plastically deforming the connection with a second expansion device. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member further comprises placing the first conventional threaded connection in tension. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member further comprises a tensional force on the first conventional threaded connection. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole. In another embodiment, the radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole. In another embodiment, the radially expanding and plastically deforming at least a portion of the third tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

[0035] In one embodiment, there is disclosed an expanded casing in a borehole located in a subterranean formation, comprising a first tubular member, a second tubular member, and a conventional threaded connection coupling the first tubular member to the second tubular member, the casing produced by the process of installing the casing in the borehole; radially expanding and plastically deforming at least a portion of the first tubular member; radially expanding and plastically deforming at least a portion of the second tubular member; and then radially expanding and plastically deforming the conventional threaded connection. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device. In another embodiment, the radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device. In another embodiment, the radially expanding and plastically deforming the conventional threaded connection comprises radially expanding and plastically deforming the connection with an expansion cone. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with a first expansion device, and wherein radially expanding and plastically deforming the conventional threaded connection comprises radially expanding and plastically deforming the connection with a second expansion device. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member and radially expanding and plastically deforming at

least a portion of the second tubular member comprises placing the conventional threaded connection in tension. In another embodiment, the radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole. In another embodiment, radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

[0036] In one embodiment, there is disclosed a method of radially expanding and plastically deforming a tubular assembly comprising a first tubular member, a second tubular member, and a mechanical coupling for coupling the first tubular member to the second tubular member, the method comprising placing the mechanical coupling in tension; and then radially expanding and plastically deforming the tubular assembly. In another embodiment, the mechanical coupling comprises a conventional threaded connection. In another embodiment, the conventional threaded connection comprises a pin and a box member.

[0037] In one embodiment, there is disclosed a method of radially expanding and plastically deforming a tubular assembly comprising a first tubular member, a second tubular member, and a mechanical coupling for coupling the first tubular member to the second tubular member, the method comprising placing the mechanical coupling in tension; and then radially expanding and plastically deforming the mechanical coupling. In another embodiment, the mechanical coupling comprises a conventional threaded connection. In another embodiment, the conventional threaded connection comprises a pin and a box member.

[0038] As illustrated in Figs. 1-3, the first tubular member 14, the second tubular member 16, and/or the conventional threaded connection 18 were radially expanded and plastically deformed into engagement with the borehole 10. Alternatively, it is contemplated that there could be a cement annulus, an existing section of casing, a sleeve member, a pre-existing structure, or space left between the first tubular member 14, the second tubular member 16, and/or the conventional threaded connection 18 and the borehole 10.

[0039] As illustrated in Fig. 2, the expanded portion of the first tubular member 14 has been radially expanded and plastically deformed into engagement with the borehole 10. Alternatively, it is contemplated that there could be a cement annulus, an existing section of casing, a sleeve member, a pre-existing structure, or space left between the first tubular member 14 and the borehole 10.

[0040] As illustrated in Fig. 2, the expanded portion of the second tubular member 16 has been radially expanded and plastically deformed into engagement with the borehole 10. Alternatively, it is contemplated that there could be a cement annulus, an existing section of casing, a sleeve member, a pre-existing structure, or space left between the second tubular member 16 and the borehole 10.

[0041] Suitable expansion devices for the expansion device 22, the first expansion device 26, and/or the second expansion device 28 include conventional expandable expansion devices commercially available from the Assignee of the present invention; Baker Oil Tools of Houston, Texas; or Weatherford Completion Systems of Houston, Texas.

[0042] Suitable expansion devices for the expansion device 22, the first expansion device 26, and/or the second expansion device 28 include expandable expansion devices as disclosed in United States patent number 6,578,630 and/or United States patent number 6,012,523, the disclosures of which are herein incorporated by reference in their entirety.

[0043] Suitable expansion devices for the expansion device 22, the first expansion device 26, and/or the second expansion device 28 include expandable expansion devices as disclosed in one or more of the Related Applications which were referenced and incorporated by reference above.

[0044] Suitable expansion devices for the second expansion device 28 include conventional expansion devices commercially available from the Assignee of the present invention; Baker Oil Tools of Houston, Texas; or Weatherford Completion Systems of Houston, Texas.

[0045] Suitable expansion devices for the second expansion device 28 include expansion devices as disclosed in one or more of Related Applications which were referenced and incorporated by reference above.

[0046] The connection 18 includes a conventional pin member on the first tubular member 14, and a conventional box member on the second tubular member 16, where the pin member and the box member are threadably engaged.

[0047] Suitable connections for the connection 18 include conventional threaded connections, conventional threaded connections with a pin and a box member, conventional welded connections, conventional butt welds, conventional flanges, conventional bolted flanges, or conventional threaded fittings.

[0048] Suitable tubular members for the string of casing 12, the first tubular member 14, and/or the second tubular member 16 include conventional tubular members commercially available from the Assignee of the present invention; Baker Oil Tools of Houston, Texas; or Weatherford Completion Systems of Houston, Texas.

[0049] Suitable tubular members for the string of casing 12, the first tubular member 14, and/or the second tubular member 16 include tubular members as disclosed in one or more of the Related Applications which were referenced and incorporated by reference above.

[0050] Although Figs. 4-6 show a bottom-up expansion of the second tubular member 16, then the first tubular member 14, it is understood that the expansion device 22, the first expansion device 26, and/or the second expansion device 28 may be used in a top-down configuration to expand the first tubular member 14, then the second tubular member 16.

[0051] In several alternative embodiments, the method of radially expanding and plastically deforming a tubular member as illustrated in Figs. 1-6, may be implemented in accordance with the teachings of one or more of the Related Applications which were referenced and incorporated by reference above.

[0052] Although illustrative embodiments of the invention have been shown and described, a wide range of modification, changes and substitution is contemplated in the foregoing disclosure. In some instances, some features of the present invention may be employed without a corresponding use of the other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.

Claims

What is claimed is:

1. A method of creating a casing in a borehole located in a subterranean formation, comprising:

installing the casing in the borehole, the casing comprising a first tubular member, a second tubular member, and a threaded connection coupling the first tubular member to the second tubular member;

radially expanding and plastically deforming at least a portion of the first tubular member;

radially expanding and plastically deforming at least a portion of the second tubular member; and

then radially expanding and plastically deforming the threaded connection.

2. The method of claim 1, wherein radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device.

3. The method of claim 1, wherein radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device.

4. The method of claim 1, wherein radially expanding and plastically deforming the threaded connection comprises radially expanding and plastically deforming the connection with an expansion cone.

5. The method of claim 1, wherein radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with a first expansion device, and wherein radially expanding and plastically deforming the threaded connection comprises radially expanding and plastically deforming the connection with a second expansion device.

6. The method of claim 1, wherein radially expanding and plastically deforming at least a portion of the first tubular member and radially expanding and plastically deforming at least a portion of the second tubular member comprises placing the threaded connection in tension.

7. The method of claim 1, wherein radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

8. The method of claim 1, wherein radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

9. A method of creating a casing in a borehole located in a subterranean formation, comprising:

installing the casing in the borehole, the casing comprising a first tubular member, a second tubular member, and a threaded connection coupling the first tubular member to the second tubular member;

placing a first expansion device and a second expansion device in the casing;

radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member with the first expansion device; and

radially expanding and plastically deforming the threaded connection with the second expansion device.

10. The method of claim 9, wherein the radially expanding and plastically deforming the threaded connection is done after radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member.

11. The method of claim 9, wherein the first expansion device is expandable.

12. The method of claim 9, wherein the first expansion device includes rotating elements.

13. A method of creating a casing in a borehole located in a subterranean formation, comprising:

installing the casing in the borehole, the casing comprising a first tubular member, a second tubular member, and a third tubular member, a first threaded connection coupling the first tubular member to the second tubular member, and a second threaded connection coupling the second tubular member to the third tubular member;

radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member;

then radially expanding and plastically deforming the first threaded connection;

radially expanding and plastically deforming at least a portion of the third tubular member; and

then radially expanding and plastically deforming the second threaded connection.

14. The method of claim 13, wherein radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device.

15. The method of claim 13, wherein radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device.

16. The method of claim 13, wherein radially expanding and plastically deforming at least a portion of the third tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device.

17. The method of claim 13, wherein radially expanding and plastically deforming the first threaded connection comprises radially expanding and plastically deforming the connection with an expansion cone.

18. The method of claim 13, wherein radially expanding and plastically deforming the second threaded connection comprises radially expanding and plastically deforming the connection with an expansion cone.

19. The method of claim 13, wherein radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with a first expansion device, and wherein radially expanding and plastically deforming the first threaded connection comprises radially expanding and plastically deforming the connection with a second expansion device.

20. The method of claim 13, wherein radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member further comprises placing the first threaded connection in tension.

21. The method of claim 13, wherein radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member further comprises a tensional force on the first threaded connection.

22. The method of claim 13, wherein radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

23. The method of claim 13, wherein radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

24. The method of claim 13, wherein radially expanding and plastically deforming at least a portion of the third tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

25. An expanded casing in a borehole located in a subterranean formation, comprising:
a first tubular member, a second tubular member, and a threaded connection coupling the first tubular member to the second tubular member, the casing produced by the process of:
installing the casing in the borehole;
radially expanding and plastically deforming at least a portion of the first tubular member;
radially expanding and plastically deforming at least a portion of the second tubular member; and
then radially expanding and plastically deforming the threaded connection.

26. The casing of claim 25, wherein radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device.

27. The casing of claim 25, wherein radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device.

28. The casing of claim 25, wherein radially expanding and plastically deforming the threaded connection comprises radially expanding and plastically deforming the connection with an expansion cone.

29. The casing of claim 25, wherein radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with a first expansion device, and wherein radially expanding and plastically deforming the threaded connection comprises radially expanding and plastically deforming the connection with a second expansion device.

30. The casing of claim 25, wherein radially expanding and plastically deforming at least a portion of the first tubular member and radially expanding and plastically deforming at least a portion of the second tubular member comprises placing the threaded connection in tension.

31. The casing of claim 25, wherein radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

32. The casing of claim 25, wherein radially expanding and plastically deforming at least a portion of the second tubular member comprises radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

33. A method of radially expanding and plastically deforming a tubular assembly comprising a first tubular member, a second tubular member, and a mechanical coupling for coupling the first tubular member to the second tubular member, the method comprising:

placing the mechanical coupling in tension; and

then radially expanding and plastically deforming the tubular assembly.

34. The method of claim 33, wherein the mechanical coupling comprises a threaded connection.

35. The method of claim 34, wherein the threaded connection comprises a pin and a box member.

36. A method of radially expanding and plastically deforming a tubular assembly comprising a first tubular member, a second tubular member, and a mechanical coupling for coupling the first tubular member to the second tubular member, the method comprising:

placing the mechanical coupling in tension; and

then radially expanding and plastically deforming the mechanical coupling.

37. The method of claim 36, wherein the mechanical coupling comprises a threaded connection.

38. The method of claim 37, wherein the threaded connection comprises a pin and a box member.

39. The method of claim 36, wherein the placing comprises engaging at least one out of the first tubular member in the second tubular member with a pre-existing structure.

40. The method of claim 39, wherein the pre-existing structure comprises a borehole.

41. A system for creating a casing in a borehole located in a subterranean formation, comprising:

means for installing the casing in the borehole, the casing comprising a first tubular member, a second tubular member, and a threaded connection coupling the first tubular member to the second tubular member;

means for radially expanding and plastically deforming at least a portion of the first tubular member;

means for radially expanding and plastically deforming at least a portion of the second tubular member; and

means for then radially expanding and plastically deforming the threaded connection.

42. The system of claim 41, wherein means for radially expanding and plastically deforming at least a portion of the first tubular member comprises means for radially expanding and plastically deforming the portion with an expandable expansion device.

43. The system of claim 41, wherein means for radially expanding and plastically deforming at least a portion of the second tubular member comprises means for radially expanding and plastically deforming the portion with an expandable expansion device.

44. The system of claim 41, wherein means for radially expanding and plastically deforming the threaded connection comprises means for radially expanding and plastically deforming the connection with an expansion cone.

45. The system of claim 41, wherein means for radially expanding and plastically deforming at least a portion of the first tubular member comprises means for radially expanding and plastically deforming the portion with a first expansion device, and wherein radially expanding and means for plastically deforming the threaded connection comprises radially expanding and plastically deforming the connection with a second expansion device.

46. The system of claim 41, wherein means for radially expanding and plastically deforming at least a portion of the first tubular member and radially expanding and plastically deforming at least a portion of the second tubular member comprises means for placing the threaded connection in tension.

47. The system of claim 41, wherein means for radially expanding and plastically deforming at least a portion of the first tubular member comprises means for radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

48. The system of claim 41, wherein means for radially expanding and plastically deforming at least a portion of the second tubular member comprises means for radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

49. A system for creating a casing in a borehole located in a subterranean formation, comprising:

means for installing the casing in the borehole, the casing comprising a first tubular member, a second tubular member, and a threaded connection coupling the first tubular member to the second tubular member;

means for placing a first expansion device and a second expansion device in the casing;

means for radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member with the first expansion device; and

means for radially expanding and plastically deforming the threaded connection with the second expansion device.

50. The system of claim 49, wherein the means for radially expanding and plastically deforming the threaded connection is done after means for radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member.

51. The system of claim 49, wherein the first expansion device is expandable.

52. The system of claim 49, wherein the first expansion device includes rotating elements.

53. A system for creating a casing in a borehole located in a subterranean formation, comprising:

means for installing the casing in the borehole, the casing comprising a first tubular member, a second tubular member, and a third tubular member, a first threaded connection coupling the first tubular member to the second tubular member, and a second threaded connection coupling the second tubular member to the third tubular member;

means for radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member;

then means for radially expanding and plastically deforming the first threaded connection;

means for radially expanding and plastically deforming at least a portion of the third tubular member; and

then means for radially expanding and plastically deforming the second threaded connection.

54. The system of claim 53, wherein means for radially expanding and plastically deforming at least a portion of the first tubular member comprises radially expanding and plastically deforming the portion with an expandable expansion device.

55. The system of claim 53, wherein means for radially expanding and plastically deforming at least a portion of the second tubular member comprises means for radially expanding and plastically deforming the portion with an expandable expansion device.

56. The system of claim 53, wherein means for radially expanding and plastically deforming at least a portion of the third tubular member comprises means for radially expanding and plastically deforming the portion with an expandable expansion device.

57. The system of claim 53, wherein means for radially expanding and plastically deforming the first threaded connection comprises means for radially expanding and plastically deforming the connection with an expansion cone.

58. The system of claim 53, wherein means for radially expanding and plastically deforming the second threaded connection comprises means for radially expanding and plastically deforming the connection with an expansion cone.

59. The system of claim 53, wherein means for radially expanding and plastically deforming at least a portion of the first tubular member comprises means for radially expanding and plastically deforming the portion with a first expansion device, and wherein means for radially expanding and plastically deforming the first threaded connection comprises means for radially expanding and plastically deforming the connection with a second expansion device.

60. The system of claim 53, wherein means for radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member further comprises means for placing the first threaded connection in tension.

61. The system of claim 53, wherein means for radially expanding and plastically deforming at least a portion of the first tubular member and at least a portion of the second tubular member further comprises means for applying a tensional force on the first threaded connection.

62. The system of claim 53, wherein means for radially expanding and plastically deforming at least a portion of the first tubular member comprises means for radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

63. The system of claim 53, wherein means for radially expanding and plastically deforming at least a portion of the second tubular member comprises means for radially expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

64. The system of claim 53, wherein means for radially expanding and plastically deforming at least a portion of the third tubular member comprises means for radially

expanding and plastically deforming the portion into engagement with at least one of a pre-existing structure and the borehole.

65. A system for radially expanding and plastically deforming a tubular assembly comprising a first tubular member, a second tubular member, and a mechanical coupling for coupling the first tubular member to the second tubular member, the method comprising:

means for placing the mechanical coupling in tension; and

then means for radially expanding and plastically deforming the tubular assembly.

66. The system of claim 65, wherein the mechanical coupling comprises a threaded connection.

67. The system of claim 66, wherein the threaded connection comprises a pin and a box member.

68. A system for radially expanding and plastically deforming a tubular assembly comprising a first tubular member, a second tubular member, and a mechanical coupling for coupling the first tubular member to the second tubular member, the method comprising:

means for placing the mechanical coupling in tension; and

then means for radially expanding and plastically deforming the mechanical coupling.

69. The system of claim 68, wherein the mechanical coupling comprises a threaded connection.

70. The system of claim 69, wherein the threaded connection comprises a pin and a box member.

71. The system of claim 68, wherein the means for placing comprises means for engaging at least one out of the first tubular member in the second tubular member with a pre-existing structure.

72. The system of claim 71, wherein the pre-existing structure comprises a borehole.

73. An apparatus, comprising:

a wellbore that traverses a subterranean formation; and

a wellbore casing positioned within and coupled to the wellbore;

wherein at least a portion of the wellbore casing is in tension.

74. The apparatus of claim 73, wherein an upper portion of the wellbore casing is radially expanded and plastically deformed and coupled to the wellbore; and wherein a lower portion of the wellbore casing, spaced apart from the upper portion, is radially expanded and plastically deformed and coupled to the wellbore.

75. The apparatus of claim 74, wherein an intermediate portion of the wellbore casing, between the upper and lower portions, is not radially expanded and plastically deformed.

76. The apparatus of claim 73, wherein the wellbore casing comprises a plurality of wellbore casings coupled to one another end to end; and wherein one or more of the couplings are in tension.

77. The apparatus of claim 76, wherein one or more of the couplings comprise threaded connections.

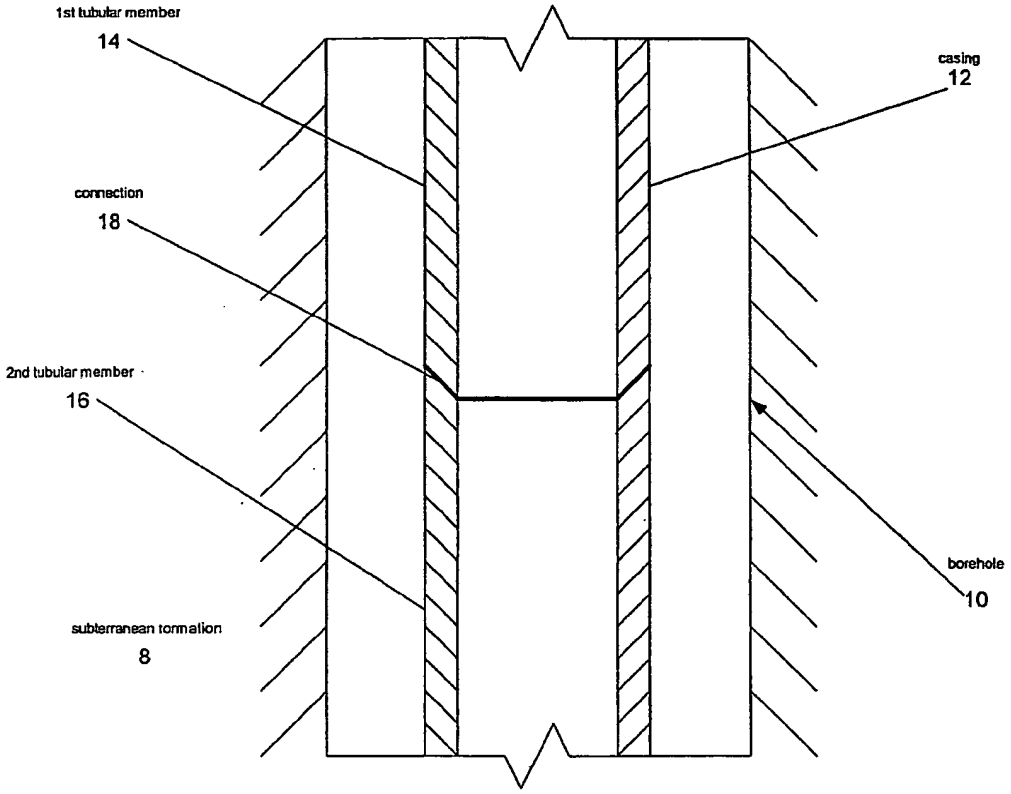
1st tubular member
14
casing
12
connection
18
2nd tubular member
16
borehole
10
subterranean formation
8

Fig. 1

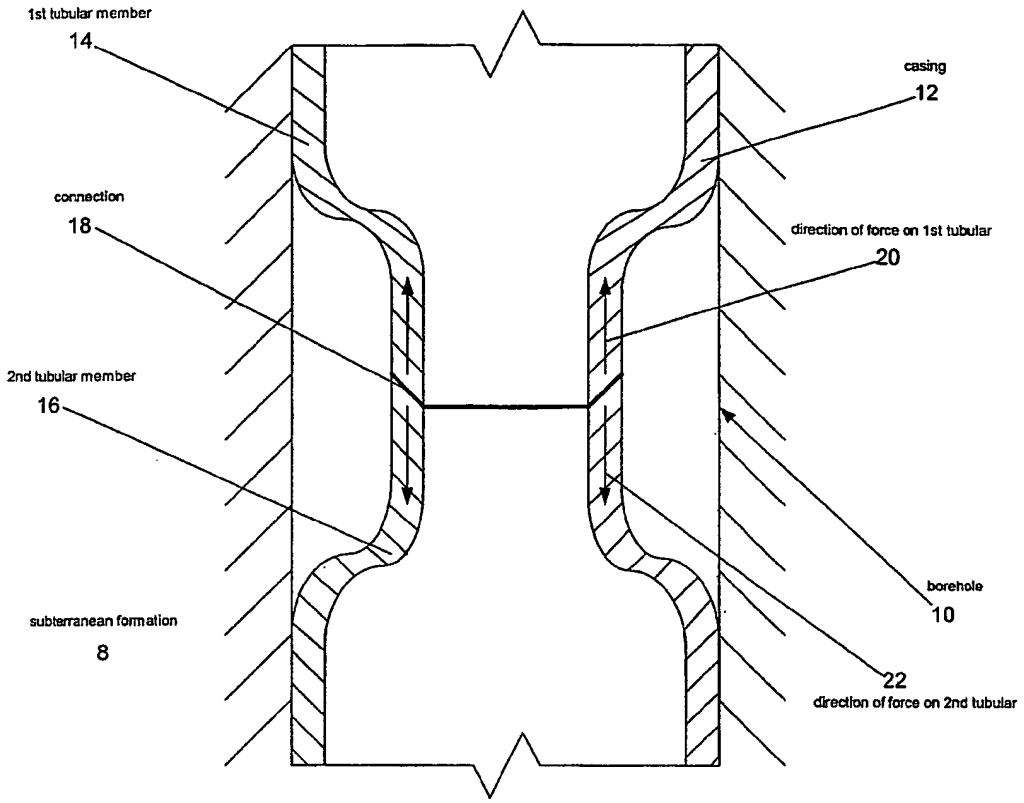
1st tubular member
14
casing
12
connection
18
direction of force on 1st tubular
20
2nd tubular member
16
borehole
10
subterranean formation
8
22
direction of force on 2nd tubular

Fig. 2

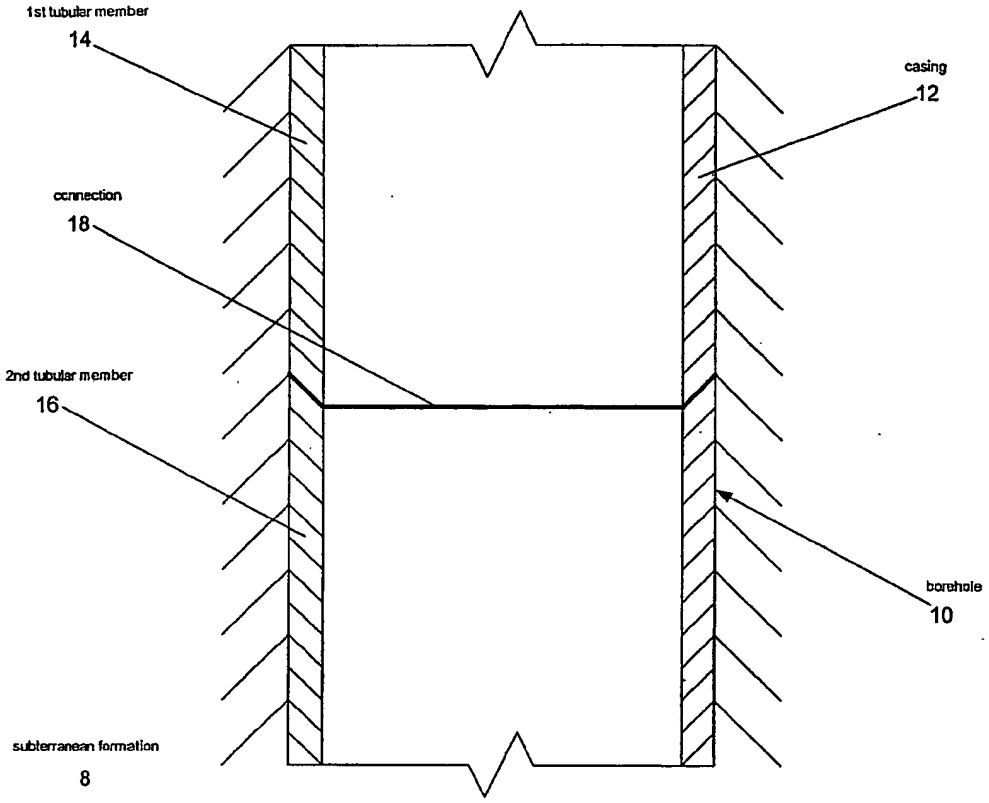
1st tubular member
14
casing
12
connection
18
2nd tubular member
16
borehole
10
subterranean formation
8

Fig. 3

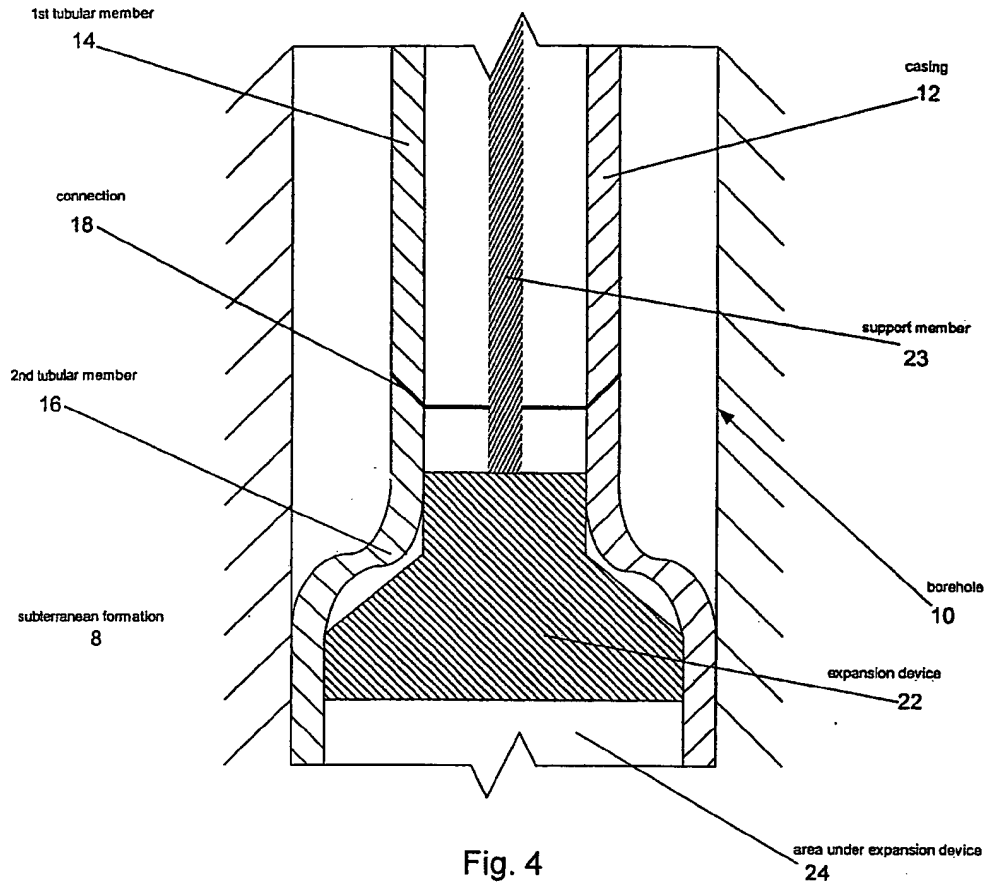
1st tubular member
14
casing
12
connection
18
support member
23
2nd tubular member
16
borehole
10
subterranean formation
8
expansion device
22
area under expansion device
24

Fig. 4

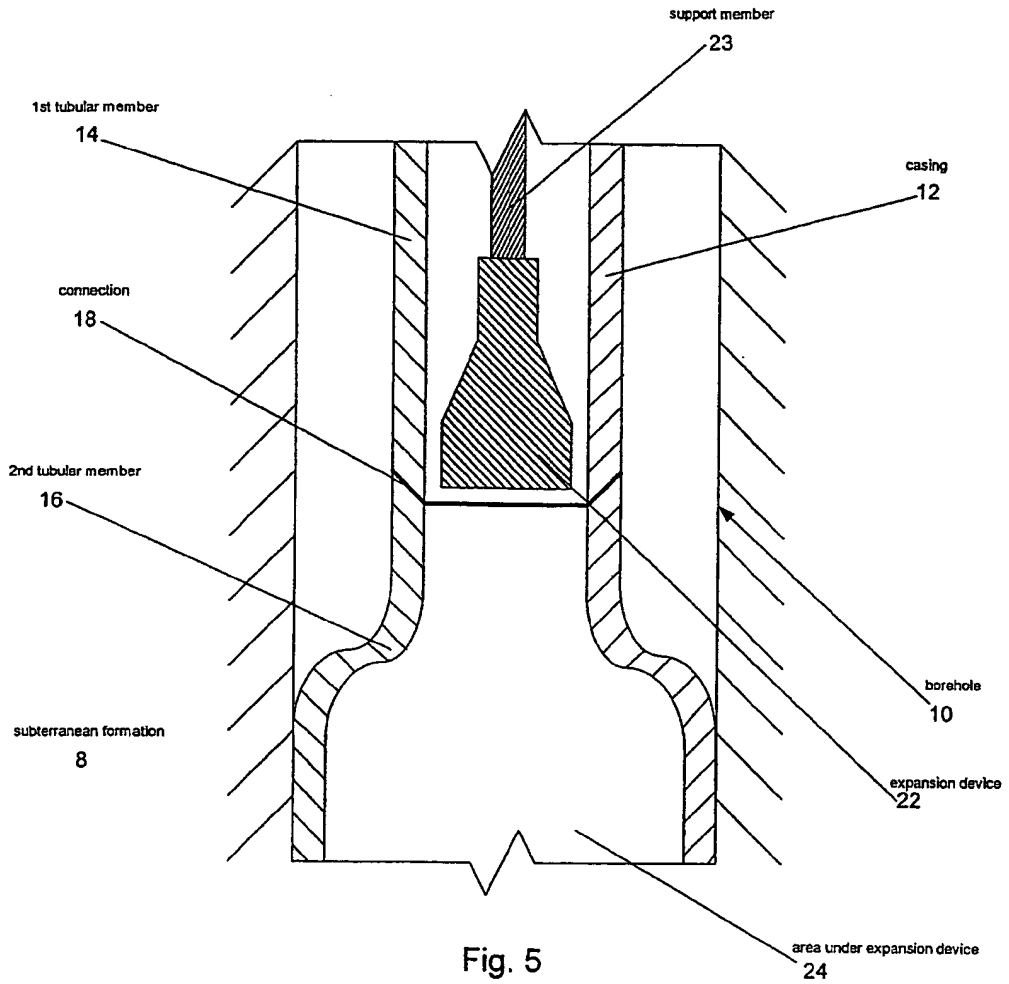
support member
23
1st tubular member
14
casing
12
connection
18
2nd tubular member
16
borehole
10
subterranean formation
8
expansion device
22
area under expansion device
24

Fig. 5

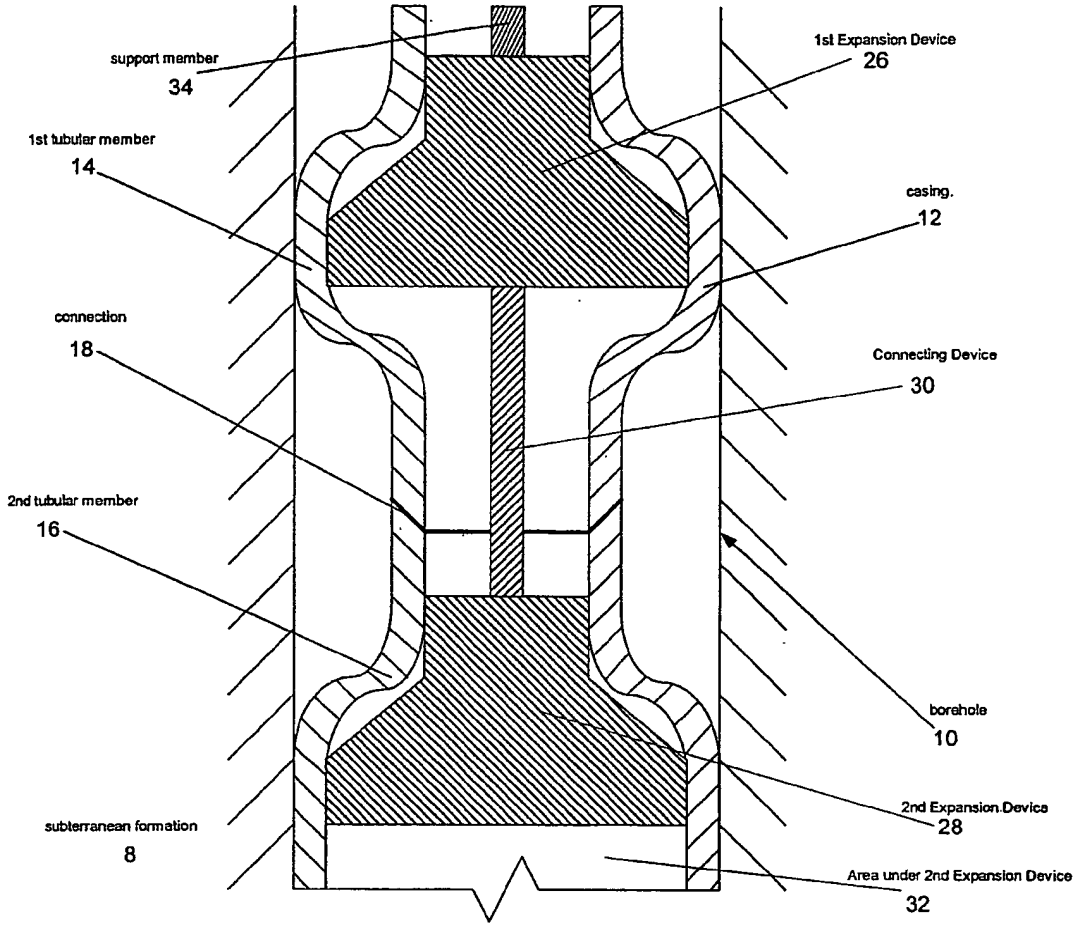
support member
34
1st tubular member
14
connection
18
2nd tubular member
16
subterranean formation
8
1st Expansion Device
26
casing.
12
Connecting Device
30
borehole
10
2nd Expansion Device
28
Area under 2nd Expansion Device
32

Fig. 6